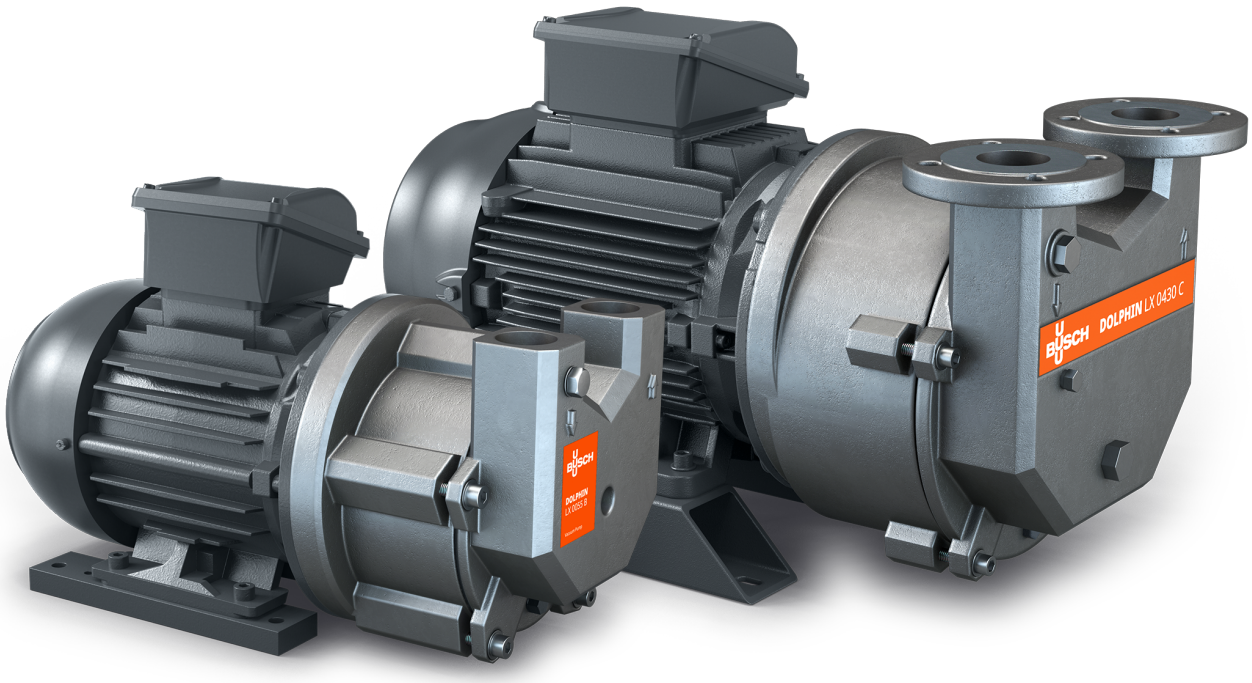
BUSCH

VACUUM SOLUTIONS

DOLPHIN

Liquid Ring Vacuum Pumps
LX 0030 B, LX 0055 B,
LX 0110 C, LX 0140 C, LX 0180 C, LX 0260 C, LX 0330 C, LX 0430 C

Instruction Manual



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VACUUM APP

CE UK CA EAC

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1 Safety

Prior to handling the machine, this instruction manual should be read and understood. If anything needs to be clarified, please contact your Busch representative.

Read this manual carefully before use and keep for future reference.

This instruction manual remains valid as long as the customer does not change anything on the product.

The machine is intended for industrial use. It must be handled only by technically trained personnel.

Always wear appropriate personal protective equipment in accordance with the local regulations.

The machine has been designed and manufactured according to state-of-the-art methods. Nevertheless, residual risks may remain, as described in the following chapters and in accordance with the chapter *Intended Use* [➔ 5]. This instruction manual highlights potential hazards where appropriate. Safety notes and warning messages are tagged with one of the keywords DANGER, WARNING, CAUTION, NOTICE and NOTE as follows:

DANGER

... indicates an imminent dangerous situation that will result in death or serious injuries if not prevented.

WARNING

... indicates a potentially dangerous situation that could result in death or serious injuries.

CAUTION

... indicates a potentially dangerous situation that could result in minor injuries.

NOTICE

... indicates a potentially dangerous situation that could result in damage to property.

NOTE

... indicates helpful tips and recommendations, as well as information for efficient and trouble-free operation.

2 Product Description

NOTE

Technical term.

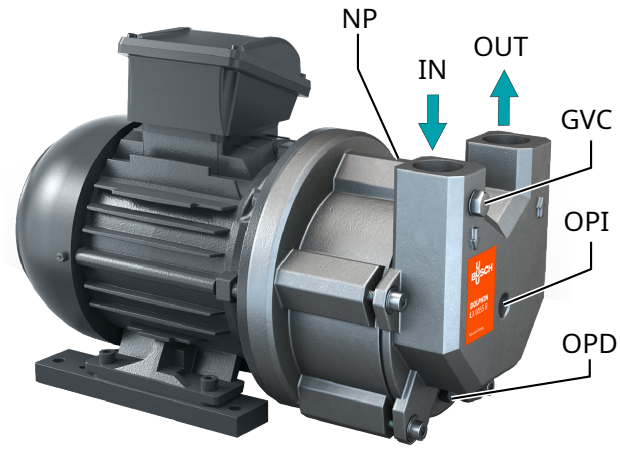
In this instruction manual, we consider that the term ‘machine’ refers to the ‘vacuum pump’.

NOTE

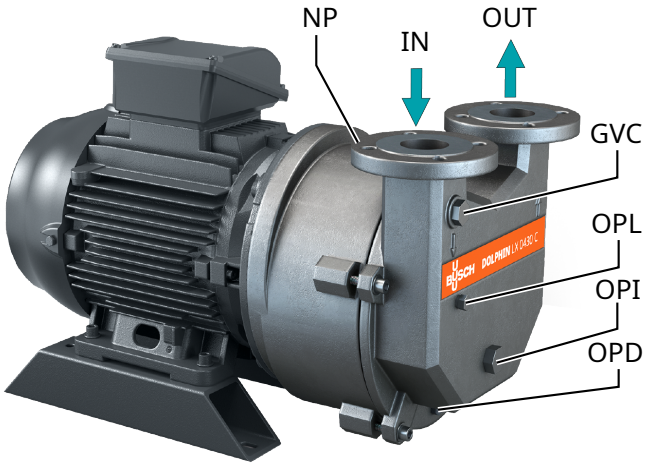
Illustrations

In this instruction manual, the illustrations may differ from the machine appearance.

DOLPHIN LX 0030-0055 B

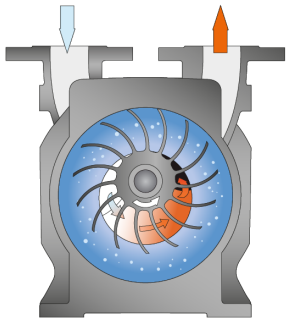


DOLPHIN LX 0110-0430 C



Description			
GVC	Vacuum gauge or relief valve connection	IN	Suction connection
NP	Nameplate	OPD	Operating liquid drain
OPI	Operating liquid inlet	OPL	Operating liquid level plug
OUT	Discharge connection		

2.1 Operating Principle



The machine works on the liquid ring principle.

An eccentrically mounted impeller rotates in a housing partially filled with operating liquid (usually water). The impeller blades dip into the fluid, and the centrifugal force exerted by their rotation forms a so-called liquid ring within the housing. The pumped medium is transported in the spaces between the blades and the liquid ring. The eccentric rotation of the impeller alters the volume of these spaces, causing gas to be drawn in, compressed and expelled.

2.2 Intended Use

WARNING

In case of foreseeable misuse outside the intended use of the machine.

Risk of injuries!

Risk of damage to the machine!

Risk of damage to the environment!

- Make sure to follow all instructions described in this manual.

The machine is intended for the suction of air, vapor and other gases.

For explosive gases and vapors (if an "Ex(inside)" sign is written on the nameplate), please refer to the ATEX supplement for additional safety information on operation in hazardous zones.

Conveying of other media leads to an increased thermal and/or mechanical load on the machine and is permissible only after a consultation with Busch.

The machine is intended for the placement in a potentially non-explosive environment unless an "Ex(outside)" sign is written on the nameplate, in this case please refer to the ATEX supplement for additional safety information.

The machine is capable of maintaining ultimate pressure, see *Technical Data* [➔ 30].

The machine is suitable for continuous operation.

Permitted environmental conditions, see *Technical Data* [➔ 30].

2.3 Start Controls

The machine comes without start controls. The control of the machine is to be provided in the course of installation.

3 Optional Accessories

3.1 Anti-cavitation valve

Anti-cavitation valve can be provided to automatically bleed air into the suction to prevent cavitation.

3.2 Suction non-return valve

Suction non-return valve can be provided to prevent operating liquid back flow through the suction pipe to the process chambers when the machine stops.

4 Transport

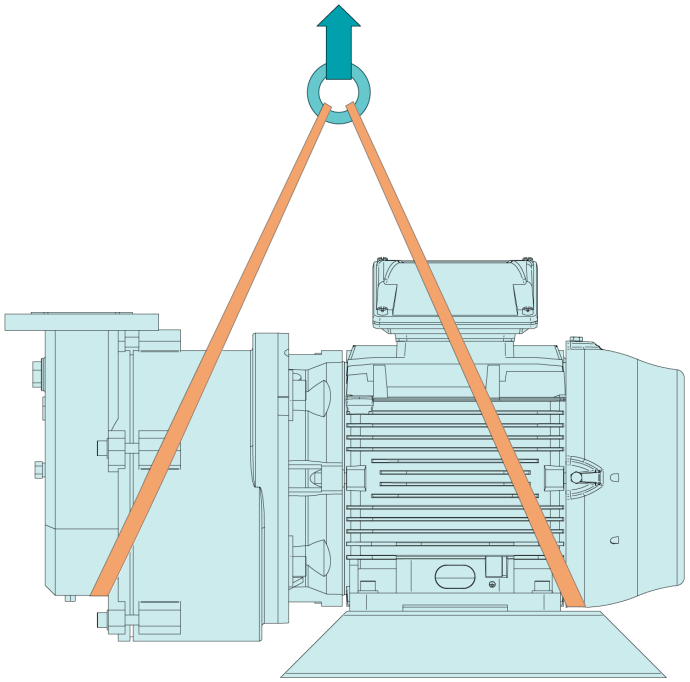
WARNING

Suspended load.

Risk of severe injury!

- Do not walk, stand or work under suspended loads.

- To find out the weight of the machine, refer to the chapter *Technical Data* [➔ 30] or the nameplate (NP).



- Check the machine for transport damage.

If the machine is secured to a base plate:

- Remove the machine from the base plate.

5 Storage

NOTICE

Storage temperature below +5°C.

Risk of damage to the machine!

- Drain the operating liquid from the machine and the system before storage.
- Or add an anti-freeze solution.

After testing, all Busch DOLPHIN vacuum pumps are vented and drained. Pumps containing ferrous materials are preserved using a combined VPI (Vapor Phase Inhibitor) and Contact Inhibitor Oil (Vaporol™ or equivalent) at a recommended concentration of 1 liter per m^3.

5.1 Short Term (Up to 3 Months)

- Seal all apertures with adhesive tape or provided caps.

If possible:

- Store the machine indoors, dry, dust free and if possible in original packaging preferably at temperatures between +5 ... 55 °C.

5.2 Medium Term (3 Months to 6 Months)

- Remove the motor fan cowl.
- Rotate the machine shaft by hand weekly to prevent bearing indentation.
- Leave the shaft at approximately 90 degrees to the original position, using a temporary mark on the shaft to assist.
- Replace the motor fan cowl correctly and ensure that all fasteners are replaced and fully tightened.

5.3 Long Term (Over 6 Months)

If the machine is constructed in cast iron material:

- Fill the pump with a liquid preservative (e.g. 'Shell Ensis Fluid') to prevent the machine from corroding.
- Remove the motor fan cowl.
- Rotate the machine shaft by hand weekly to prevent bearing indentation.
- Leave the shaft at approximately 90 degrees to the original position, using a temporary mark on the shaft to assist.
- Replace the motor fan cowl correctly and ensure that all fasteners are replaced and fully tightened.

6 Installation

6.1 Installation Conditions

NOTICE

Use of the machine outside of the permitted installation conditions.

Risk of premature failure!

Loss of efficiency!

- Take care that the installation conditions are fully complied with.

- Make sure that the environment of the machine is not potentially explosive.

If there is an Ex(o) sign written on the nameplate:

- Please refer to the ATEX supplement for additional safety information.

- Make sure that the ambient conditions comply with the *Technical Data* [➔ 30].
- Make sure that the environmental conditions comply with the protection class of the motor.
- Make sure that the installation space or location is protected from weather and lightning.
- Make sure that the installation space or location is vented such that sufficient cooling of the machine is provided.
- Make sure that cooling air inlets and outlets are not covered or obstructed and that the cooling air flow is not affected adversely in any other way.
- Make sure that enough space remains for maintenance work.
- Make sure that the machine is placed or mounted horizontally on a flat surface.
- Make sure that the machine is connected to an operating liquid system, see Operating Liquid Connection.
- Make sure that all provided covers, guards, hoods, etc. are mounted.

If the machine is installed at an altitude greater than 1000 meters above sea level:

- Contact your Busch representative, the motor should be derated or the ambient temperature limited.

6.2 Connecting Lines / Pipes

- Remove all protective covers before installation.
- Make sure that the connection lines cause no stress on the connections of the machine. Therefore, we recommend installing flexible joints on the suction and discharge connections.
- Make sure that the line size of the connection lines over the entire length is at least as large as the connections of the machine.

In case of long connection lines, it is advisable to use larger line sizes in order to avoid a loss of efficiency. Seek advice from your Busch representative.

6.2.1 Suction Connection

NOTICE

Ingress of foreign objects.

Risk of damage to the machine!

If the inlet gas contains foreign solid particles:

- Install a suitable inlet screen (smaller than 0.1 mm mesh size) upstream of the machine.

Connection size(s):

  - G1" / 1" NPT depending on contract requirement (for LX 0030-0055 B)
  - DN40 PN16 / 1 ½" NB ANSI B16.5 150lb (for LX 0110-0180 C)
  - DN50 PN16 / 2" NB ANSI B16.5 150lb (for LX 0260-0330 C)
  - DN65 PN16 / 2 ½" NB ANSI B16.5 150lb (for LX 0430 C)

- Make sure that the connection lines cause no stress on the connections of the machine. Therefore, we recommend installing flexible joints on the suction and discharge connections.

6.2.2 Discharge Connection

NOTICE

Discharge gas flow obstructed.

Risk of damage to the machine!

- Make sure that the discharged gas will flow without obstruction. Do not shut off or throttle the discharge line or use it as a pressurized air source.

NOTICE

Too high elevation or lack of separation.

Will cause back pressure and possible drive motor overload!

- The discharge piping should not exceed an elevation of more than 600 mm above the discharge flange (OUT) of the machine until the liquid is separated.

Connection size(s):

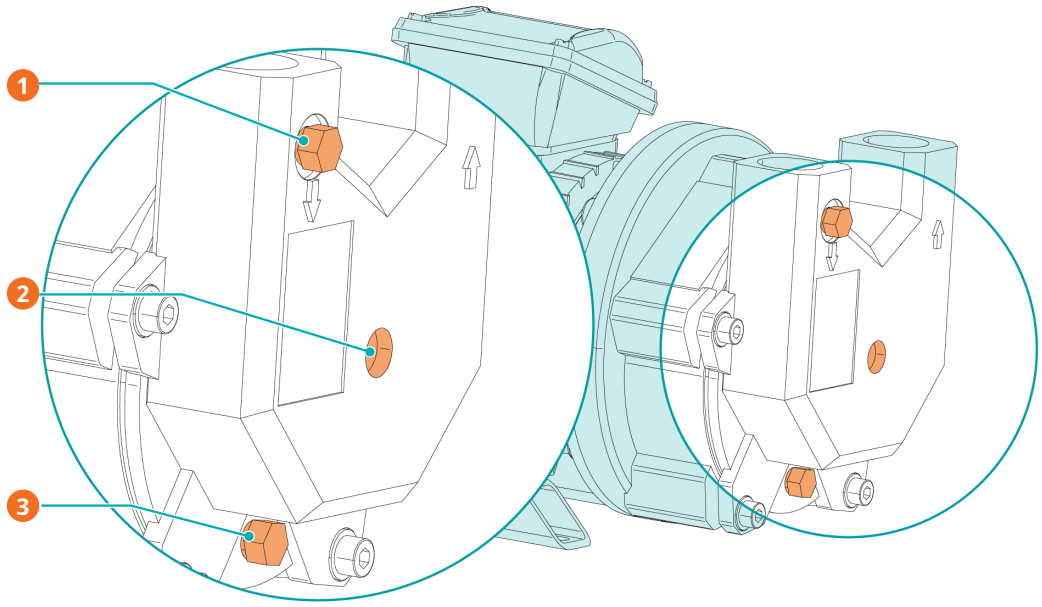
  - G1" / 1" NPT depending on contract requirement (for LX 0030-0055 B)
  - DN40 PN16 / 1 ½" NB ANSI B16.5 150lb (for LX 0110-0180 C)
  - DN50 PN16 / 2" NB ANSI B16.5 150lb (for LX 0260-0330 C)
  - DN65 PN16 / 2 ½" NB ANSI B16.5 150lb (for LX 0430 C)

- Make sure that the connection lines cause no stress on the connections of the machine. Therefore, we recommend installing flexible joints on the suction and discharge connections.

6.2.3 Operating Liquid Connection

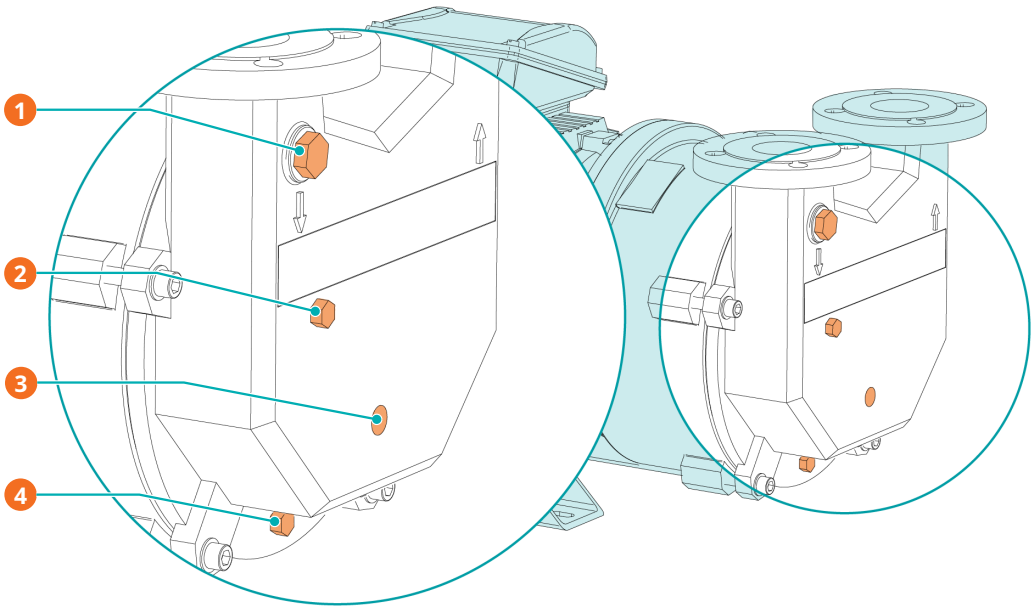
The machine cannot be operated without an operating liquid system. The following diagrams show examples of typical installations. The actual scope of delivery is always contractually agreed upon.

DOLPHIN LX 0030-0055 B



Description			
1	Vacuum gauge or relief valve (GVC)	2	Operating liquid inlet (OPI)
3	Operating liquid drain (OPD)		

DOLPHIN LX 0110-0430 C



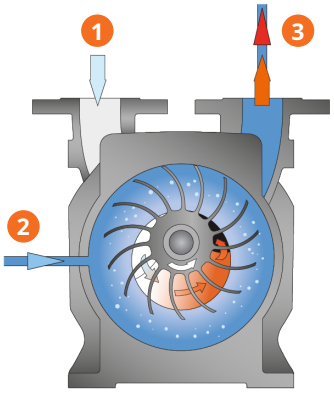
Description			
1	Vacuum gauge or relief valve (GVC)	2	Operating liquid level plug (OPL)
3	Operating liquid inlet (OPI)	4	Operating liquid drain (OPD)

Connection sizes:

Machine type	OPD	OPI	OPL	GVC
LX 0030-0055 B	G¼"	G⅜"	N/A	G¼"
LX 0110-0180 C	G⅜"	G½"	G⅜"	G½"
LX 0260-0330 C	G⅜"	G½"	G⅜"	G½"
LX 0430 C	G⅜"	G½"	G⅜"	G¾"

- LX 0030-0055 B connections can be NPT depending on contract requirement.
- Make sure that the operating liquid complies with the requirements, see Operating Liquid Settings.

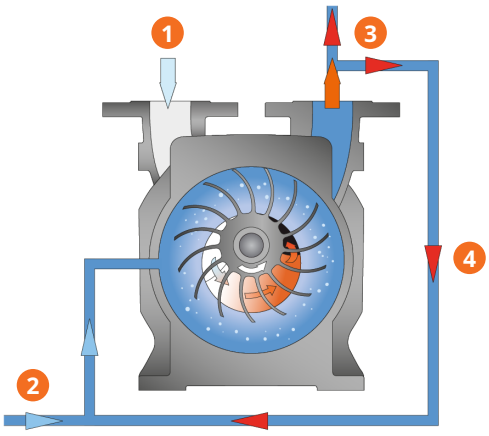
6.2.3.1 Once-Through Operation / No recovery



Description			
1	Process inlet (IN)	2	Operating liquid inlet (OPI)
3	Gas and operating liquid discharge (OUT)		

Continuous flow liquid system does not recover the operating liquid which flows out with the discharge gases.

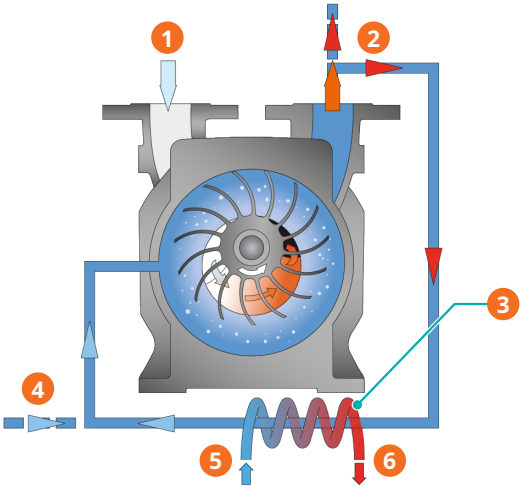
6.2.3.2 Partial Recovery (Open Circuit)



Description			
1	Process inlet (IN)	2	Operating liquid inlet (OPI)
3	Gas and operating liquid discharge (OUT)	4	50% of operating liquid recovered

Partial recirculation liquid system reduces the consumption of fresh liquid by recovering and recirculating 50% of the operating liquid.

6.2.3.3 Total Recovery (Closed Circuit)



Description			
1	Process inlet (IN)	2	Gas and operating liquid discharge (OUT)
3	Heat exchanger (HE)	4	Topping-up operating liquid
5	Cooling water inlet (CWI)	6	Cooling water outlet (CWO)

Total recirculation liquid system recovers all of the operating liquid which is cooled by a heat exchanger.

The recommended maximum pressure drop across the total recirculation system heat exchanger is 150 mbar on the machine side.

6.3 Operating Liquid Settings

The condition of both the operating liquid and the conveyed media depends on the physical conditions pressure and temperature.

At very low pressures and sufficiently high temperatures the operating liquid can locally transfer into the vapor phase, creating bubbles within the operating liquid. This process is called “cavitation” and may deteriorate the machine and its performance, see *Preventing Cavitation* [➔ 21].

Recommended operating liquid settings:

Fresh water flow rate (once through operation only)	m^3/h	See *Technical Data* [➔ 30]
Water pressure before flow regulation valve (once through operation only)	bar	1
Max. allowable supply temperature	°C	40
Max. allowable kinematic viscosity	mm^2/s	4 *Consider the motor power for anything other than water - consult Busch.*
Max. allowable particle size	mm	0.1*

* For all operating systems make sure that no particles with a diameter larger than 0.1mm will enter the machine, neither via the process gas nor via the operating liquid. Use suitable filtration as necessary.

The table below lists the recommended maximum levels of soluble compounds for use with machines in cast iron construction.

Calcium carbonate	mg/l (ppm)	< 300**
pH value		6.5 ... 9.5
Chloride	mg/l (ppm)	< 700
Sulphates	mg/l (ppm)	< 200
Nitrites	mg/l (ppm)	< 500***
Total dissolved solids	mg/l (ppm)	< 1000

** to prevent excessive build-up of scale
*** provided long period of exposure to stagnant water is not foreseen

NOTE

Stainless steel version.

Please note that machines in all stainless-steel material offer higher levels of corrosion resistance and can be used for operation outside of the above limits. Chemical compatibility should always be checked by competent personnel before use, particular attention should be paid to elastomer material selection. If in doubt, please consult Busch.

7 Electrical Connection

DANGER

Live wires.

Risk of electrical shock.

- Electrical installation work must only be executed by qualified personnel.

CURRENT PROTECTION OF THE CUSTOMER INSTALLATION:

DANGER

Missing current protection.

Risk of electrical shock.

- Current protection in accordance with EN 60204-1 must be provided by the customers on their installation(s).
- The electrical installation must comply with the applicable national and international standards.

NOTICE

Electromagnetic compatibility.

- Make sure that the motor of the machine will not be affected by electric or electromagnetic disturbance from the mains, if necessary seek advice from Busch.
- Make sure that the EMC of the machine is compliant with the requirements of your supply network system, if necessary provide further interference suppression (EMC of the machine, see *EU Declaration of Conformity* [➔ 33] or *UK Declaration of Conformity* [➔ 34]).

7.1 Machine delivered without Control Box or Variable Speed Drive (VSD)

DANGER

Live wires.

Risk of electrical shock.

- Electrical installation work must only be executed by qualified personnel.

NOTE

The operation with variable speed, i.e. with a variable speed drive or a soft starter unit, is allowed as long as the motor is capable and the permitted motor speed range is respected (see *Technical Data* [➔ 30]).

Seek advice from your Busch representative.

- Make sure that the power supply for the motor is compatible with the data on the nameplate of the motor.
- If the machine is equipped with a power connector, install a residual current protective device to protect persons in case of a defective insulation.
  - Busch recommends installing a type B residual protective device suitable for the electrical installation.
- Provide a lockable disconnect switch or an emergency stop switch on the power line so that the machine is completely secured in case of an emergency situation.
- Provide a lockable disconnect switch on the power line so that the machine is completely secured during maintenance tasks.
- Provide an overload protection according to EN 60204-1 for the motor.
- Connect the protective earth conductor.
- Electrically connect the motor.

NOTICE

The motor frequency is too low.

Loss of efficiency, not enough power to create the sealing liquid ring.

- The motor speed must always be higher than the minimum speeds shown in the *Technical Data* [➔ 30].

NOTICE

Incorrect connection.

Risk of damage to the motor!

- The wiring diagrams given below are typical. Check the inside of the terminal box for motor connection instructions/diagrams.

7.2 Machine delivered with a Variable Speed Drive (Option)

- If the machine is equipped with a power connector, install a residual current protective device to protect persons in case of a defective insulation.
  - Busch recommends installing a type B residual protective device suitable for the electrical installation.
- If the variable speed drive is not equipped with a lockable disconnect switch, provide it on the power line so that the machine is completely secured during maintenance tasks.
- Provide an overload protection according to EN 60204-1.
- Connect the protective earth conductor.

NOTICE

Incorrect connection.

Risk of damage to the variable speed drive!

- The wiring diagrams given below are typical. Check the connection instructions/diagrams.

7.3 Wiring Diagram Three-Phase Motor

NOTICE

Incorrect direction of rotation.

Risk of damage to the machine!

- Operation in the wrong direction of rotation can destroy the machine in a short time! Prior to start-up, ensure that the machine is operated in the right direction.

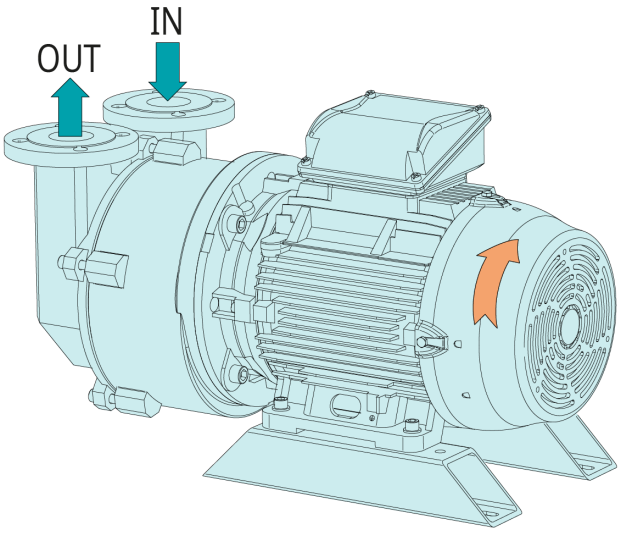
NOTICE

Incorrect direction of rotation.

Risk of damage to the vacuum system!

- Operating the vacuum system with the rotation in the wrong direction can result in the operating liquid flowing back to the vacuum system. Prior to start-up, check for correct direction of rotation.

The intended rotation direction of the motor is defined by the illustration below:

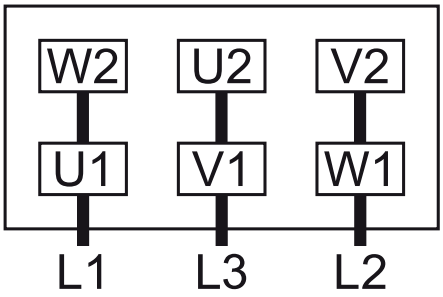


- Watch the fan wheel of the motor and determine the direction of rotation just before the fan wheel stops.

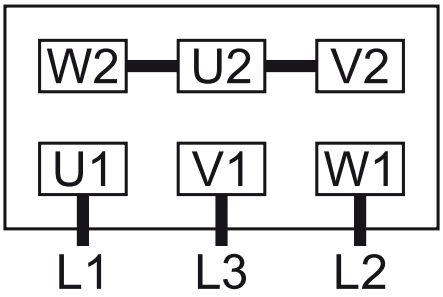
If the rotation of the motor must be changed:

- Switch any two of the motor phase wires.

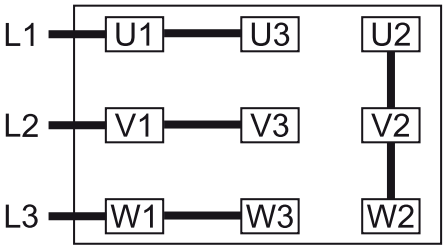
Delta connection, ‘Europe’ or ‘Europe / USA’ motor with 6 pins (low voltage):



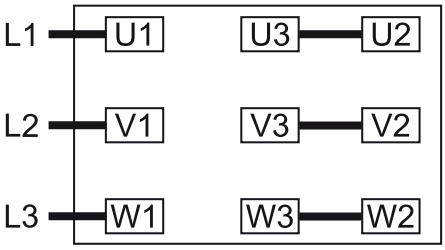
Star connection, ‘Europe’ or ‘Europe / USA’ motor with 6 pins (high voltage):



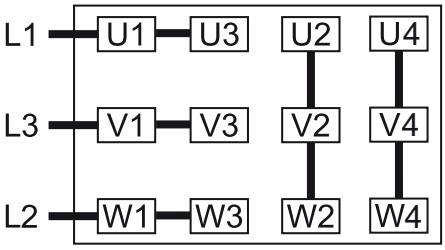
Double star connection, multi-voltage motor with 9 pins (low voltage):



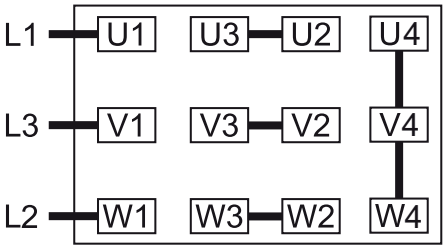
Star connection, multi-voltage motor with 9 pins (high voltage):



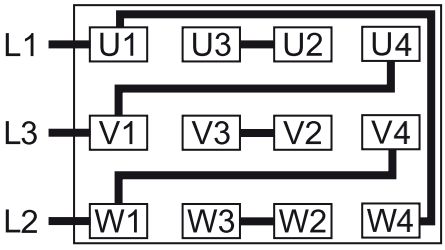
Double star connection, multi-voltage motor with 12 pins (low voltage):



Star connection, multi-voltage motor with 12 pins (high voltage):



Delta connection, multi-voltage motor with 12 pins (middle voltage):



8 Commissioning

CAUTION

During operation the surface of the machine may reach temperatures of more than 70°C.

Risk of burns!

- Avoid contact with the machine during and directly after operation.

NOTICE

The machine is running without operating liquid system.

Will ruin the machine in short time!

- Prior to commissioning, the operating liquid system must be connected and open.

NOTICE

The machine is running with closed (blanked) suction.

Risk of damage to the machine!

- Prior to starting, make sure the suction line is open. The machine is not ultimate pressure proof and so requires gas load to prevent cavitation.

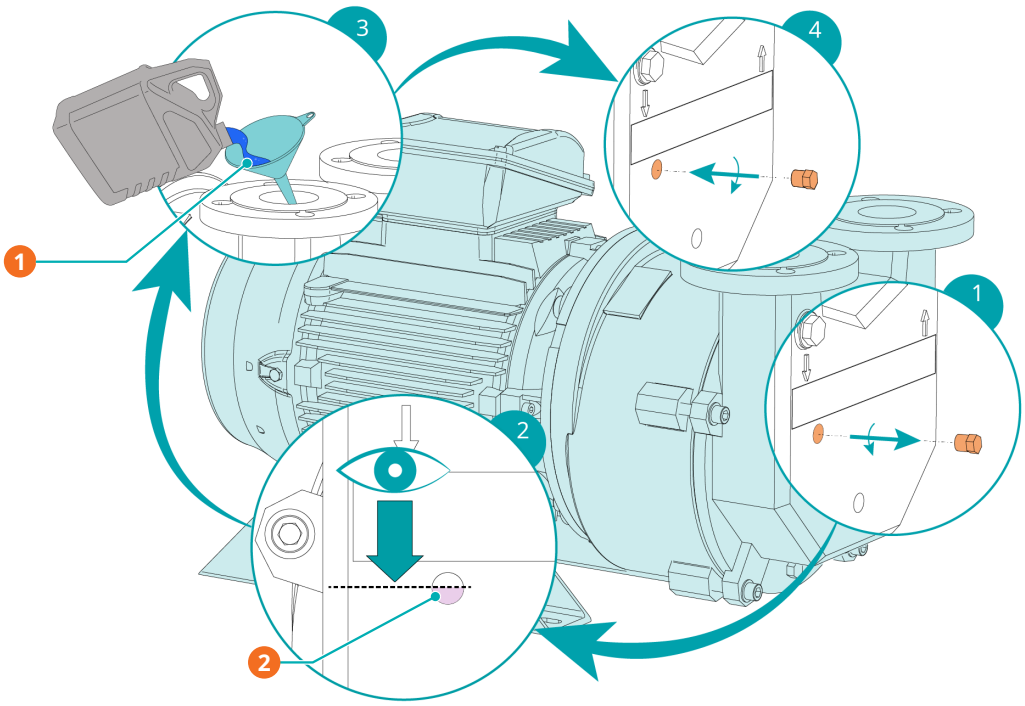
- Make sure that the *Installation Conditions* [➔ 8] are met.
- Make sure that the operating conditions comply with the *Technical Data* [➔ 30].

As soon as the machine is operated under normal operating conditions:

- Measure the motor current and record it as reference for future maintenance and trouble-shooting work.

8.1 First time Start-up

- Before operating the machine:
- Make sure that the operating liquid level is at the machine shaft center - connection (OPI) on LX 0030 – 0055 B, for LX 0110 – 0430 C: remove the operating liquid level plug (OPL) to verify liquid level.



Description			
1	Allow to drain or add operating liquid. Add via pump connections or operating liquid supply.	2	Check operating liquid at casing center line.

- Check the operation of all automatic valves before startup.
- Open suction valve
- Open the cooling water valve for heat exchanger (if installed).
- Start the machine.
- Make sure that the maximum permissible number of starts does not exceed 12 starts per hour. Those starts should be spread within the hour.
- Turn on/activate the operating liquid system up to 10 seconds after machine start.
- Regulate operating liquid flow in line with the *Technical Data* [➔ 30].

As soon as the machine is operated under normal operating conditions:

- Measure the motor current and record it as reference for future maintenance and trouble-shooting work.

8.2 Regular Start-up

- Open suction valve
- Open the cooling water valve for heat exchanger (if installed).
- Start the machine.
- Turn on/activate the operating liquid system up to 10 seconds after machine start.

8.3 Regular Shut down

- Turn off operating liquid system.
- After approximately 10 seconds, switch off machine.
- Close suction valve.
- Close the cooling water valve for heat exchanger.

8.4 Preventing Cavitation

NOTICE

Cavitation.

Risk of damage to the machine!

If you hear crackling noise:

- Control the pressure.

At very low pressures and sufficiently high temperatures the operating liquid can locally transfer into the vapor phase, creating bubbles within the operating liquid. As the pressure rises towards the outlet slot the bubbles collapse. This process is called cavitation.

In case of bubbles that have been located on surfaces the operating liquid cannot intrude the cavity left by the bubble equally from all directions. Instead, the inflowing liquid hits the surface with high speed. This causes erosion, which can destroy the machine rapidly. The formation of bubbles also deteriorates the pump performance. Cavitation is clearly audible by its crackling noise.

The working pressure of the vacuum pump shall therefore be sufficiently above the vapor pressure of the operating liquid. In particular, the pressure control in the vacuum system must by no means be achieved by throttling or even closing of the suction line!

The vapor pressure of the operating liquid and consequently the ultimate pressure can be reduced by lowering the temperature of the operating liquid. However in most cases, the low ultimate pressure is not required and cavitation shall be avoided by means of vacuum limitation rather than temperature reduction.

9 Maintenance

DANGER

Live wires.

Risk of electrical shock.

- Electrical installation work must only be executed by qualified personnel.

WARNING

Machines contaminated with hazardous material.

Risk of poisoning!

Risk of infection!

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

CAUTION

Hot surface.

Risk of burns!

- Prior to any action requiring touching the machine, let the machine cool down first.

- Shut down the machine and lock against inadvertent start up.
- Turn off the operating liquid system.
- Vent the connected lines to atmospheric pressure.

If necessary:

- Drain the operating liquid
- Disconnect all connections

9.1 Maintenance Schedule

The maintenance intervals depend very much on the individual operating conditions. The intervals given below are considered as starting values which should be shortened or extended as appropriate. Particularly harsh applications or heavy duty operation, such as high dust loads in the environment or in the process gas, other contamination or ingress of process material, can make it necessary to shorten the maintenance intervals significantly.

Interval	Maintenance work
Monthly	• Check for abnormal noise, see *Troubleshooting* [➔ 28]. • Temperature checks in the general area of the bearings. • Check for excessive vibration (if not being continuously monitored), see Operating Conditions. • Check the operating liquid temperature, see Operating Liquid Connection. • Check the machine for liquid leaks - in case of leaks have the machine repaired (contact Busch).

Interval	Maintenance work
Every year	• Carry out a visual inspection on the machine to check for dust and dirt. Avoid using any cleaning products which may result in damage to the pump label or paint. If an inlet screen is installed: • Check it and clean if necessary.
Every 30000 operating hours or after 5 years	• Have a major overhaul (contact Busch).

10 Overhaul

WARNING

Machines contaminated with hazardous material.

Risk of poisoning!

Risk of infection!

If the machine is contaminated with hazardous material:

- Wear appropriate personal protective equipment.

NOTICE

Improper assembly.

Risk of premature failure!

Loss of efficiency!

- Any dismantling of the machine that goes beyond anything that is described in this manual should be done by Busch authorized technicians.

In case of the machine having conveyed gas that was contaminated with foreign materials which are dangerous to health:

- Decontaminate the machine as much as possible and state the contamination status in a 'Declaration of Contamination'.

Busch will only accept machines that come with a completely filled in and legally binding signed 'Declaration of Contamination' (form downloadable from *www.buschvacuum.com*).

11 Decommissioning

DANGER

Live wires.

Risk of electrical shock.

- Electrical installation work must only be executed by qualified personnel.

CAUTION

Hot surface.

Risk of burns!

- Prior to any action requiring touching the machine, let the machine cool down first.

- Shut down the machine and lock against inadvertent start up.
- Disconnect the power supply.
- Vent the connected lines to atmospheric pressure.
- Disconnect all connections.

If the machine is going to be stored:

- See Storage.

11.1 Dismantling and Disposal

- Separate special waste from the machine.
- Dispose of special waste in compliance with applicable regulations.
- Dispose of the machine as scrap metal.

12 Spare Parts

NOTICE

Use of non-Busch genuine spare parts.

Risk of premature failure!

Loss of efficiency!

- The exclusive use of Busch genuine spare parts and consumables is recommended for the correct functioning of the machine and to validate the warranty.

Spare parts kit	Description	Part no.
Service kit for: LX 0030 B LX 0055 B	Intended for standard applications 1x Mechanical seal (Viton elastomers) 2x Casing O-rings 1x Sealing nut O-ring 1x Valve plate	0993700017
Service kit for: LX 0030 B LX 0055 B	Intended for chemical applications 1x Mechanical seal (FFKM elastomers) 2x Casing O-rings 1x Sealing nut O-ring 1x Valve plate	0993700069
Service kit for: LX 0110 C LX 0140 C LX 0180 C	Intended for standard applications 1x Mechanical seal (Viton elastomers) 2x Casing O-rings 1x Sealing nut O-ring 1x Valve plate	0993700018
Service kit for: LX 0110 C LX 0140 C LX 0180 C	Intended for chemical applications 1x Mechanical seal (FFKM elastomers) 2x Casing O-rings 1x Sealing nut O-ring 1x Valve plate	0993700070
Service kit for: LX 0260 C	Intended for standard applications 1x Mechanical seal (Viton elastomers) 2x Casing O-rings 1x Sealing nut O-ring 1x Valve plate	0993700035
Service kit for: LX 0260 C	Intended for chemical applications 1x Mechanical seal (FFKM elastomers) 2x Casing O-rings 1x Sealing nut O-ring 1x Valve plate	0993700071
Service kit for: LX 0330 C	Intended for standard applications 1x Mechanical seal (Viton elastomers) 2x Casing O-rings 1x Sealing nut O-ring 1x Valve plate	0993700037
Service kit for: LX 0330 C	Intended for chemical applications 1x Mechanical seal (FFKM elastomers) 2x Casing O-rings 1x Sealing nut O-ring 1x Valve plate	0993700072

Spare parts kit	Description	Part no.
Service kit for: LX 0430 C	Intended for standard applications 1x Mechanical seal (Viton elastomers) 2x Casing O-rings 1x Sealing nut O-ring 1x Valve plate	0993700038
Service kit for: LX 0430 C	Intended for chemical applications 1x Mechanical seal (FFKM elastomers) 2x Casing O-rings 1x Sealing nut O-ring 1x Valve plate	0993700073

If other parts are required:

- Contact your Busch representative.

13 Troubleshooting

Problem	Possible Cause	Remedy
The machine does not start.	The motor is not supplied with the correct voltage.	• Check the power supply.
	Corrosion between the rotor and the housing.	• Eliminate by use of anti-corrosion liquid. • Repair the machine (contact Busch).
	Solid foreign matter has entered the machine.	• Remove the solid foreign matter or repair the machine (contact Busch). • Install an inlet screen if necessary.
	Ice in the machine, the operating liquid has frozen.	• Carefully warm up the machine. • Defrost the operating liquid.
	The motor is defective.	• Replace the motor.
The machine does not reach the usual pressure on the suction connection.	Suction or discharge lines too long or section diameter too small.	• Use larger diameter or shorter lines. • Seek advice from your local Busch representative.
	The operating liquid is too warm or insufficient operating liquid. (the characteristic curves are based on 15°C warm water as operating liquid, with higher temperatures the achieved pressure and the flow rate deteriorate)	• Reduce the temperature of the operating liquid or adjust the flow of operating liquid.
	The mechanical seal leaks.	• Repair the machine (contact Busch).
	Partial clogging in the suction, discharge or pressure line.	• Remove the blockage.
	If an inlet screen is installed, it can be partially clogged.	• Clean the inlet screen.
	Internal parts are worn or damaged.	• Repair the machine (contact Busch).

Problem	Possible Cause	Remedy
The machine runs very noisily or rattles.	The operating liquid level is too high.	• Adjust the regulating valves to drain the pump down to center line.
	Density or viscosity of the operating liquid too high.	• Check Operating Liquid Settings. • Provide a different operating liquid or a stronger drive motor.
	The machine runs in the wrong direction.	• Check the direction of rotation, see *Wiring Diagram Three-Phase Motor* [➔ 17].
	Defective bearings.	• Repair the machine (contact Busch).
	The vacuum pump cavitates (periodic formation and collapsing of steam bubbles in the operating liquid).	• Consult the chapter *Preventing Cavitation* [➔ 21].
The machine runs too hot.	Insufficient air ventilation.	• Make sure that the cooling of the machine is not impeded by dust/dirt. • Clean the fan cowling, the fan, the ventilation grill and the cooling fins of the motor.
	Ambient temperature too high.	• Observe the permitted ambient temperature, see *Technical Data* [➔ 30].
	Temperature of the process gases at the inlet too high.	• Observe the permitted gas inlet temperature, see *Technical Data* [➔ 30].
	Insufficient gas transfer.	• Introduce a suitable inert gas or air via the anti-cavitation connection.
	Partial blockage in the suction, discharge or pressure line.	• Remove the blockage.

14 Technical Data

		LX 0030 B	LX 0055 B
Pumping speed (50Hz / 60Hz)	m^3/h	25 / 31	47 / 56
Ultimate pressure (50Hz / 60Hz)	hPa (mbar) abs.	33 / 33	
Maximum overpressure (50Hz / 60Hz)	bar(g)	1	
Nominal motor rating IEC (50Hz / 60Hz)	kW	1.1 / 1.5	1.5 / 2.2
Nominal motor speed (50Hz / 60Hz)	min^{-1}	2900 / 3500	
Permitted motor speed range	min^{-1}	2200 ... 3800 (~37 ... 63 Hz)	
Noise level (EN ISO 2151) (50Hz / 60Hz)	dB(A)	≤70	
Vibration velocity – unfiltered (RMS)	mm/s (in/s)	≤4.0 (≤0.16)	
Max. allowable gas inlet temperature	°C	Gas dry ► 100	
		Gas saturated ► 80	
Ambient temperature range	°C	5 ... 40	
Relative humidity	at 30 °C	90%	
Ambient pressure		Atmospheric pressure	
Operating liquid requirements (once through operation only)	m^3/h	33 mbar(a) ► 0.3 400 mbar(a) ► 0.24 800 mbar(a) ► 0.12	33 mbar(a) ► 0.3 400 mbar(a) ► 0.24 800 mbar(a) ► 0.12
Weight with motor 50 Hz Europe motor / 50 & 60 Hz*	kg	28 / 37	36 / 39

***** Based on cast iron pump with standard motor supply, may vary with contract specific motor.

		LX 0110 C	LX 0140 C	LX 0180 C
Pumping speed (50Hz / 60Hz)	m^3/h	72 / 83	100 / 120	122 / 144
Ultimate pressure (50Hz / 60Hz)	hPa (mbar) abs.	33 / 33		
Maximum overpressure (50Hz / 60Hz)	bar(g)	1		
Nominal motor rating IEC (50Hz / 60Hz)	kW	2.2 / 3.0	3.0 / 4.0	4.0 / 5.5
Nominal motor speed (50Hz / 60Hz)	min^{-1}	1450 / 1750		
Permitted motor speed range	min^{-1}	1200 ... 1800 (~41 ... 60 Hz)		
Noise level (EN ISO 2151) (50Hz / 60Hz)	dB(A)	≤70		
Vibration velocity – unfiltered (RMS)	mm/s (in/s)	≤4.0 (≤0.16)		
Max. allowable gas inlet temperature	°C	Gas dry ► 100		
		Gas saturated ► 80		
Ambient temperature range	°C	5 ... 40		
Relative humidity	at 30 °C	90%		
Ambient pressure		Atmospheric pressure		
Operating liquid requirements (once through operation only)	m^3/h	33 mbar(a) ► 0.9 400 mbar(a) ► 0.6 800 mbar(a) ► 0.12	33 mbar(a) ► 1.0 400 mbar(a) ► 0.6 800 mbar(a) ► 0.12	33 mbar(a) ► 1.08 400 mbar(a) ► 0.66 800 mbar(a) ► 0.12
Weight with motor 50 Hz Europe motor / 50 & 60 Hz *	kg	76 / 82	87 / 94	91 / 118

* Based on cast iron pump with standard motor supply, may vary with contract specific motor.

		LX 0260 C	LX 0330 C	LX 0430 C
Pumping speed (50Hz / 60Hz)	m^3/h	200 / 239	280 / 330	375 / 455
Ultimate pressure (50Hz / 60Hz)	hPa (mbar) abs.	33 / 33		
Maximum overpressure (50Hz / 60Hz)	bar(g)	1		
Nominal motor rating IEC (50Hz / 60Hz)	kW	5.5 / 7.5	7.5 / 11.0	11.0 / 15.0
Nominal motor speed (50Hz / 60Hz)	min^{-1}	1450 / 1750		
Permitted motor speed range	min^{-1}	1100 ... 1800 (~38 ... 60 Hz)		910 ... 1800 (~31 ... 60 Hz)
Noise level (EN ISO 2151) (50Hz / 60Hz)	dB(A)	≤72		
Vibration velocity – unfiltered (RMS)	mm/s (in/s)	≤4.0 (≤0.16)		
Max. allowable gas inlet temperature	°C	Gas dry ► 100		
		Gas saturated ► 80		
Ambient temperature range	°C	5 ... 40		
Relative humidity	at 30 °C	90%		
Ambient pressure		Atmospheric pressure		
Operating liquid requirements (once through operation only)	m^3/h	33 mbar(a) ► 1.5 400 mbar(a) ► 0.9 800 mbar(a) ► 0.18	33 mbar(a) ► 1.62 400 mbar(a) ► 1.08 800 mbar(a) ► 0.66	33 mbar(a) ► 2.04 400 mbar(a) ► 1.26 800 mbar(a) ► 0.9
Weight with motor 50 Hz Europe motor / 50 & 60 Hz *	kg	130 / 138	144 / 170	219 / 241

* Based on cast iron pump with standard motor supply, may vary with contract specific motor.

15 EU Declaration of Conformity

This Declaration of Conformity and the CE-markings affixed to the nameplate are valid for the machine within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.

When this machine is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process for the superordinate machine or plant, issue the Declaration of Conformity for it and affix the CE-marking.

The manufacturer is determined by the serial number:

Serial number starts with **600...**

Busch GVT Ltd.
Westmere Drive, Crewe Business Park
Crewe, Cheshire, CW1 6ZD
United Kingdom

Serial number starts with **INM1...**

Busch Manufacturing India Pvt Ltd
B100, Indospace Logistic Park
Chakan Khed-Taluka, Pune-Maharashtra
India

declares that the machine: DOLPHIN LX 0030 B: DOLPHIN LX 0055 B; DOLPHIN LX 0110 C; DOLPHIN LX 0140 C; DOLPHIN LX 0180 C; DOLPHIN LX 0260 C; DOLPHIN LX 0330 C; DOLPHIN LX 0430 C

fulfill(s) all the relevant provisions from EU directives:

- 'Machinery' 2006/42/EC
- 'Electromagnetic Compatibility' (EMC) 2014/30/EU
- 'RoHS' 2011/65/EU Restriction of the use of certain hazardous substances in electrical and electronic equipment (incl. all related applicable amendments)

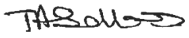
and comply(-ies) with the following harmonized standards that have been used to fulfill those provisions:

Standards	Title of the Standard
EN ISO 12100 : 2010	Safety of machinery - Basic concepts, general principles of design
EN ISO 13857 : 2019	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-2 : 1996 + A1 : 2009	Vacuum pumps - Safety requirements - Part 2
EN ISO 2151 : 2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1 : 2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN IEC 61000-6-2 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments
EN IEC 61000-6-4 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments
ISO 21940-1 : 2019	Mechanical vibration – Rotor balancing

Legal person authorized to compile the technical file
and authorized representative in the EU
(if the manufacturer is not located in the EU):

Busch Dienste GmbH
Schauinslandstr. 1
DE-79689 Maulburg

Crewe, 15.02.2023



Tracey Sellars, General Manager

Chakan Khed-Taluka, Pune-Maharashtra, 15.02.2023

Vivek Jaripatke, Plant Operations Manager

16 UK Declaration of Conformity

This Declaration of Conformity and the UKCA-markings affixed to the nameplate are valid for the machine within the Busch scope of delivery. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.

When this machine is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process for the superordinate machine or plant, issue the Declaration of Conformity for it and affix the UKCA-marking.

The manufacturer is determined by the serial number:

Serial number starts with **600...**

Busch GVT Ltd.
Westmere Drive, Crewe Business Park
Crewe, Cheshire, CW1 6ZD
United Kingdom

Serial number starts with **INM1...**

Busch Manufacturing India Pvt Ltd
B100, Indospace Logistic Park
Chakan Khed-Taluka, Pune-Maharashtra
India

declares that the machine: DOLPHIN LX 0030 B: DOLPHIN LX 0055 B; DOLPHIN LX 0110 C; DOLPHIN LX 0140 C; DOLPHIN LX 0180 C; DOLPHIN LX 0260 C; DOLPHIN LX 0330 C; DOLPHIN LX 0430 C

fulfill(s) all the relevant provisions from UK legislations:

- Supply of Machinery (Safety) Regulations 2008
- Electromagnetic Compatibility Regulations 2016
- Restriction of the use of certain hazardous substances in Electrical and Electronic Equipment Regulations 2021

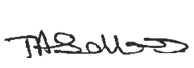
and comply(-ies) with the following designated standards that have been used to fulfill those provisions:

Standards	Title of the Standard
EN ISO 12100 : 2010	Safety of machinery - Basic concepts, general principles of design
EN ISO 13857 : 2019	Safety of machinery - Safety distances to prevent hazard zones being reached by the upper and lower limbs
EN 1012-2 : 1996 + A1 : 2009	Vacuum pumps - Safety requirements - Part 2
EN ISO 2151 : 2008	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1 : 2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN IEC 61000-6-2 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments
EN IEC 61000-6-4 : 2019	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments
ISO 21940-1 : 2019	Mechanical vibration – Rotor balancing

Legal person authorized to compile the technical file
and importer in the UK
(if the manufacturer is not located in the UK):

Busch GVT Ltd
Westmere Drive, Crewe Business Park
Crewe, Cheshire - UK

Crewe, 15.02.2023



Tracey Sellars, General Manager

Chakan Khed-Taluka, Pune-Maharashtra, 15.02.2023

Vivek Jaripatke, Plant Operations Manager

Notes

Busch
Vacuum Solutions

With a network of over 60 companies in more than 40 countries and agencies worldwide, Busch has a global presence. In every country, highly competent local personnel delivers custom-tailored support backed by a global network of expertise. Wherever you are. Whatever your business. We are there for you.

Busch companies and Busch employees Local representatives and distributors Busch production site

www.buschvacuum.com

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